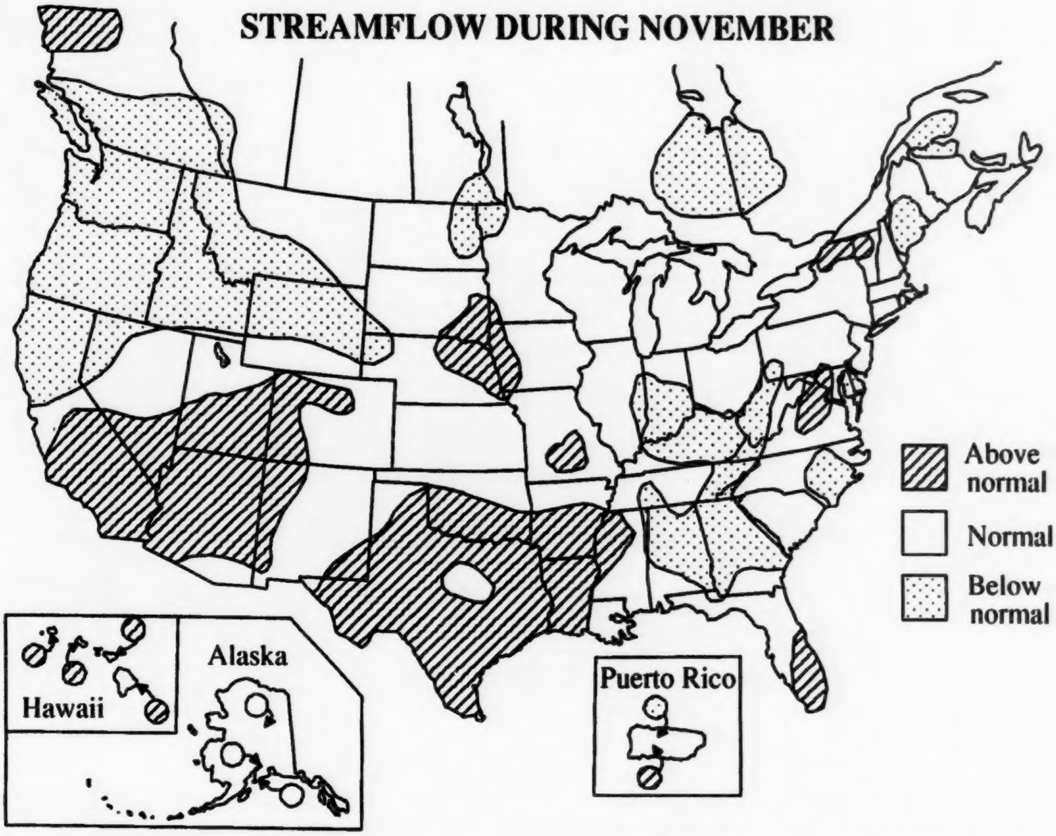
National Water Conditions

UNITED STATES
Department of the Interior
Geological Survey

CANADA
Department of the Environment
Water Resources Branch

NOVEMBER 1987

STREAMFLOW DURING NOVEMBER



Heavy rains totalling 16-18 inches on November 15-16 caused severe floods in central Louisiana on November 16. Peak discharge at two gaging stations exceeded both the 100-year flood and the previous flood of record, and peak discharge exceeded the flood of record but not the 100-year flood at five other gages.

Below-normal streamflow persisted in Washington and Oregon, most of Idaho, parts of Montana, Wyoming, Nevada, and California, parts of the Southeast, and several small areas in southern Canada and the northern United States.

Streamflow was in the normal to above-normal range at 73.2 percent of the 190 reporting index stations in southern Canada, the United States, and Puerto Rico, compared with the 66.3 percent in those ranges for last month. This is the lowest percentage of stations with flow in the normal to above-normal range for November in the last 6 years. Total November flow of 1,116,280 cubic feet per second (cfs) was 13.6 percent below median, 17.8 percent below last month's total, and the lowest for November in the last 6 years: about 464,000 cfs or 20 percent below that of November 1982, the second lowest November during the period.

Mean November elevations for the Great Lakes (provisional National Ocean Service data) were below those for last month and last November at the master gages on all four lakes.

The level of Utah's Great Salt Lake did not change during November, remaining at 4,209.45 feet above National Geodetic Vertical Datum of 1929 throughout the month.

Contents of 70 percent of reporting reservoirs were near or above average for the end of November, compared with 76 percent for the end of October.

The combined flow of the 3 largest rivers in the lower 48 States--Mississippi, St. Lawrence, and Columbia--averaged a below-normal 561,100 cfs (about 15 percent below median) during November after decreasing about 2 percent from October to November.

SURFACE-WATER CONDITIONS DURING NOVEMBER 1987

Heavy rains totalling 16-18 inches on November 15-16 caused severe floods in the central part of Louisiana (see maps on page 3) on November 16. Peak discharge at two gaging stations exceeded both the 100-year flood and the previous flood of record, and peak discharge exceeded the flood of record but not the 100-year flood at five other gages. For example, Chickasaw Creek near Olla (drainage area 47.6 square miles) peaked at 28,000 cubic feet per second (cfs) on November 16, about 2.3 times the discharge for the 100-year flood, about 17,600 cfs more than the previous maximum, and at a stage 1.97 feet higher than the previous maximum. Recurrence intervals for the floods were highly variable (see table on page 3), even in adjacent basins with drainage areas of about the same size. No damage estimates were available.

Below-normal streamflow persisted in Washington and Oregon, most of Idaho, parts of Montana, Wyoming, Nevada, and California, parts of the Southeast, and several small areas in southern Canada and the northern United States. Monthly mean flows were in the below-normal range at 16 of the 17 index streamflow stations in Montana, Idaho, Washington, and Oregon. Bar graphs comparing total mean with total median from September 1985 through November 1987 for the index stations in those four States are on page 14. The graphs show that streamflow for April through June 1987 is well below that for April through June 1986, and that dry conditions have persisted through November 1987. The only other area in which similar dry conditions have occurred during the same period is in the Southeast (those States in the area from the Mississippi River to the Atlantic Ocean and south of the Ohio River-Pennsylvania State Line). In contrast, however, streamflow in the Southeast is higher in 1987 than in 1986. The same type of bar graphs are used to show conditions at 39 index stations (excluding the Mississippi River and Ohio River) in the Southeast for the same period.

Flows generally decreased from October to November in only a few areas: seasonally in Alaska, Alberta, and Montana; variably in Idaho; and contraseasonally in Saskatchewan and also the area from Massachusetts to Maine. Flows changed seasonally in Wyoming and Iowa, variably in Ontario, Quebec, Pennsylvania, Florida, and Puerto Rico, and remained unchanged in South Dakota. Streamflow generally increased in the rest of southern Canada and the United States: variably in Arizona, Utah, Colorado, North Dakota, Minnesota, and Georgia; contraseasonally in British Columbia, Texas, Oklahoma, Kansas, and Missouri; and seasonally in all other areas.

Streamflow was in the normal to above-normal range at 73.2 percent of the 190 reporting index stations in southern Canada, the United States, and Puerto Rico, compared with the 66.3 percent in those ranges for last month. This is the lowest percentage of stations with flow in the normal to above-normal range for November in the last 6 years. Total November flow of 1,116,280 cfs was 13.6 percent below median, 17.8 percent below last month's total, and the lowest for November in the last 6 years: about 464,000 cfs or 20 percent below that of November 1982, the second lowest November during the period.

The only November low occurred on the Clearwater River at Spalding, Idaho (drainage area 9,750 square miles), where the monthly mean discharge of 1,050 cfs (20 percent of median) was the lowest in 65 years of record, 733 cfs less than the previous record of 1,783 cfs, set in 1936. The only new maximum for November occurred on Fisheating Creek at Palmdale, Florida (drainage area 311 square miles), where the monthly mean of 1,131 cfs (2,217 percent of median), was the highest in 56 years of record, 586 cfs more than the previous record of 545 cfs, set in 1969. Hydrographs of streamflow at eight index stations, including those at which new November extremes occurred, are on page 5. The hydrographs on the left side are for sites at which flows are currently above normal and those on the right are for sites at which flows are currently below normal.

Mean November elevations for the Great Lakes (provisional National Ocean Service data) declined from last month at the master gages on all four lakes: on Lake Superior by 0.20 foot, which was in the normal range for the eighth consecutive month; on Lake Huron by 0.30 foot, which was in the normal range for the fourth consecutive month; on Lake Erie by 0.28 foot, which was in the above-normal range for the 42nd consecutive month (since June 1984); and on Lake Ontario by 0.27 foot, which was in the normal range for November, despite the decline, after 2 consecutive months in the below-normal range. Levels ranged from 1.11 feet (Lake Superior) to 2.25 feet (Lake Huron) lower than those for November 1986. Stage hydrographs at the master gages for Lakes Superior, Huron, Erie, and Ontario are on page 6.

The level of Utah's Great Salt Lake (see graph on page 6) did not change during November, remaining at 4,209.45 feet above National Geodetic Vertical Datum (NGVD) of 1929 throughout the month. Lake level is 2.40 feet lower than the March 30, 1987, seasonal high of 4,211.85 feet above NGVD of 1929, and 1.60 feet lower than a year ago. The monthend level is the second highest recorded for November, exceeded only by levels recorded in November 1986, when the lake was already 2 1/2 months into the seasonal rise.

Contents of 70 percent of reporting reservoirs were near or above average for the end of November, compared with 76 percent for the end of October. Most reporting reservoirs in Vermont, Massachusetts, New York, New Jersey, Pennsylvania, South Carolina, Georgia, Alabama, Nebraska, Texas, Arizona, New Mexico, and Colorado had contents that were more than 5 percent of normal maximum contents above the average for the end of November. In contrast, most reporting reservoirs in Quebec, Montana, Idaho, Washington, California, and Nevada had contents that were more than 5 percent of normal maximum contents below the average for the end of November.

(Continued on page 14.)

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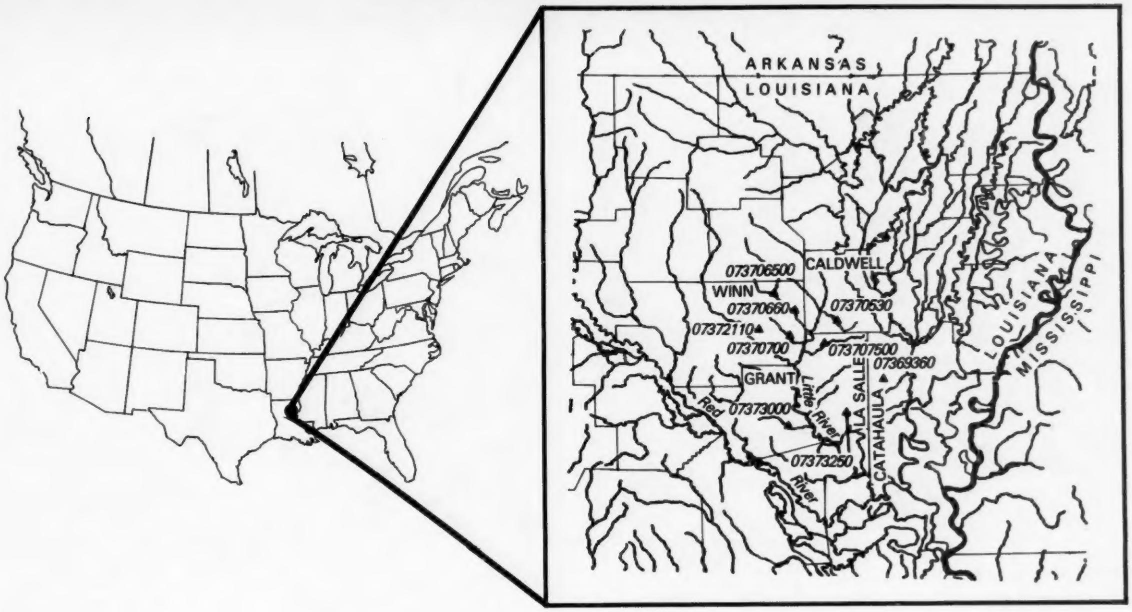
LOCATION OF FLOODS IN LOUISIANA



Provisional data; subject to revision

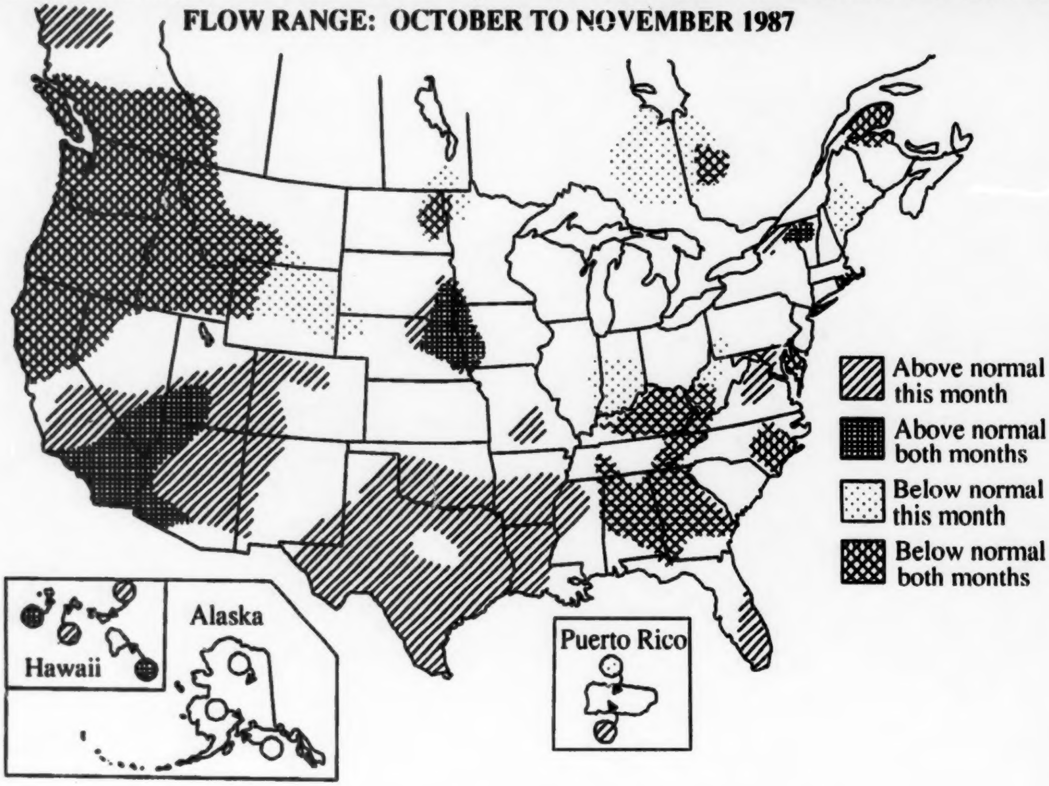
FLOOD DATA FOR SELECTED SITES IN LOUISIANA, NOVEMBER, 1987

WRD Station number	Stream and place of determination	Drainage area (square miles)	Period of known floods	Maximum flood previously known: Date	Maximum flood previously known: Stage (feet)	Maximum flood previously known: Discharge (cfs)	Maximum during present flood: Date	Maximum during present flood: Stage (feet)	Discharge: Cfs	Discharge: Cfs per square mile	Recurrence interval (years)
07369360	Bushley Creek near Manifest	64.7	1985-	Oct. 21, 1984	39.98	6,990	Nov. 16	42.94	15,500	240	(a)
07370530	Black Bayou at Kelly	51.9	1966-	Dec. 28, 1982	42.66	14,600	16	43.84	26,500	511	[b]1.9
07370650	Flat Creek near Sikes	41.5	1950-	Dec. 27, 1982	13.28	11,200	16	13.96	15,200	366	35
07370660	Flat Creek near Olla	103	1965-	Apr. 12, 1974	50.98	17,500	16	49.79	11,900	116	10
07370700	Beech Creek near Olla	58	1953-	Apr. 12, 1974	46.78	23,900	16	46.30	19,800	341	25
07370750	Chickasaw Creek near Olla	47.6	1953-	Feb. 10, 1966	43.22	10,400	16	45.19	28,000	588	[b]2.3
07372110	Brushy Creek near Joyce	24	1964-	Apr. 12, 1974	47.63	14,800	16	47.77	16,000	667	40
07373000	Big Creek at Pollock	51	1942-	Apr. 29, 1953	18.03	14,200	16	18.60	15,500	304	(a)
07373250	Hemphill Creek near Nebo	35.3	1978-	Dec. 27, 1982	14.2	13,600	16	14.93	15,200	431	(a)

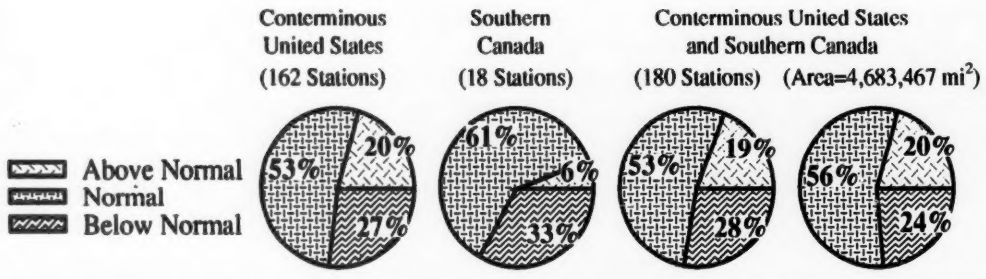
[a] Not determined.

[b] Recurrence interval greater than 100 years. Value shown is approximate ratio of discharge to that of 100-year flood.

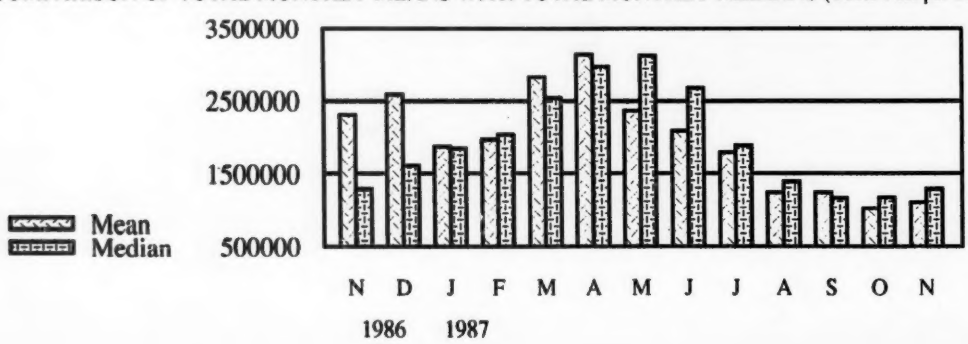
PERSISTENCE IN, OR MOVEMENT INTO, THE BELOW-NORMAL OR ABOVE-NORMAL FLOW RANGE: OCTOBER TO NOVEMBER 1987



SUMMARY OF NOVEMBER 1987 STREAMFLOW
FLOW RANGES

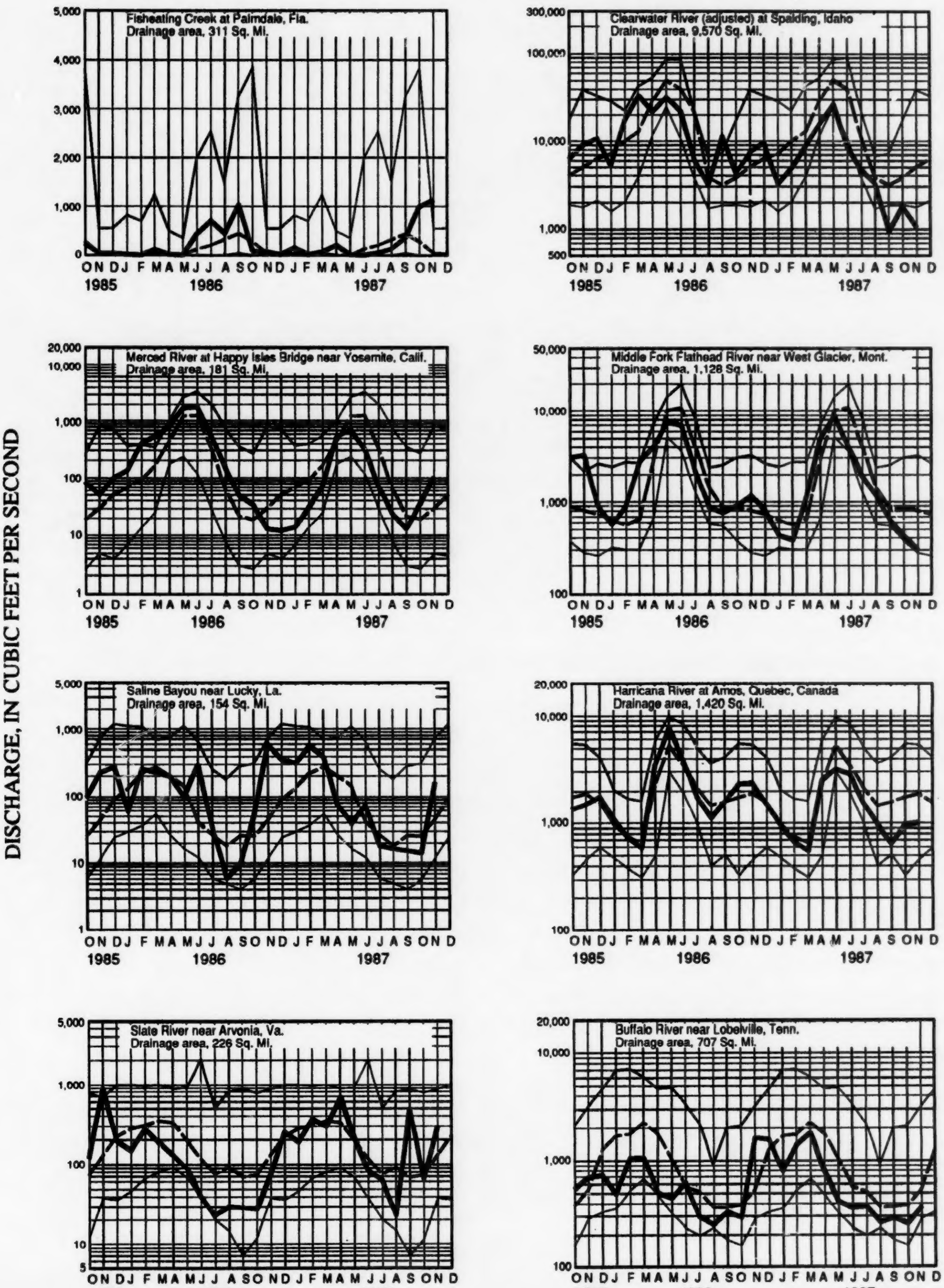


COMPARISON OF TOTAL MONTHLY MEANS WITH TOTAL MONTHLY MEDIANS (Cubic Feet per Second)



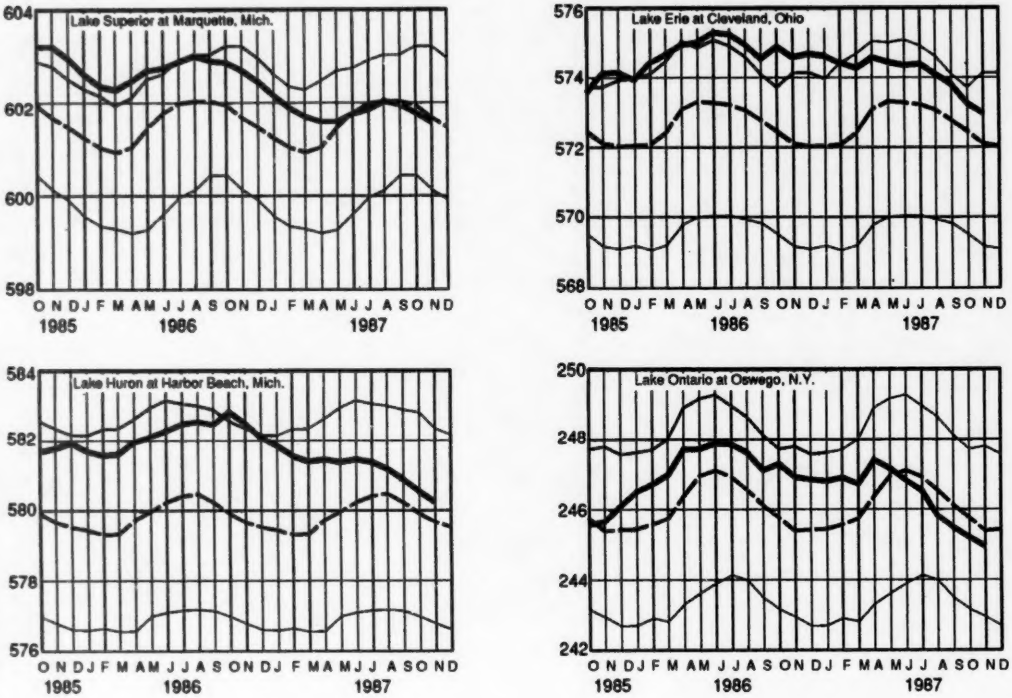
MONTHLY MEAN DISCHARGE OF SELECTED STREAMS

Area between light-weight solid lines indicates range between highest and lowest record for the month. Dashed line indicates median of monthly values for reference period, 1951-80. Heavy line indicates mean for current period.



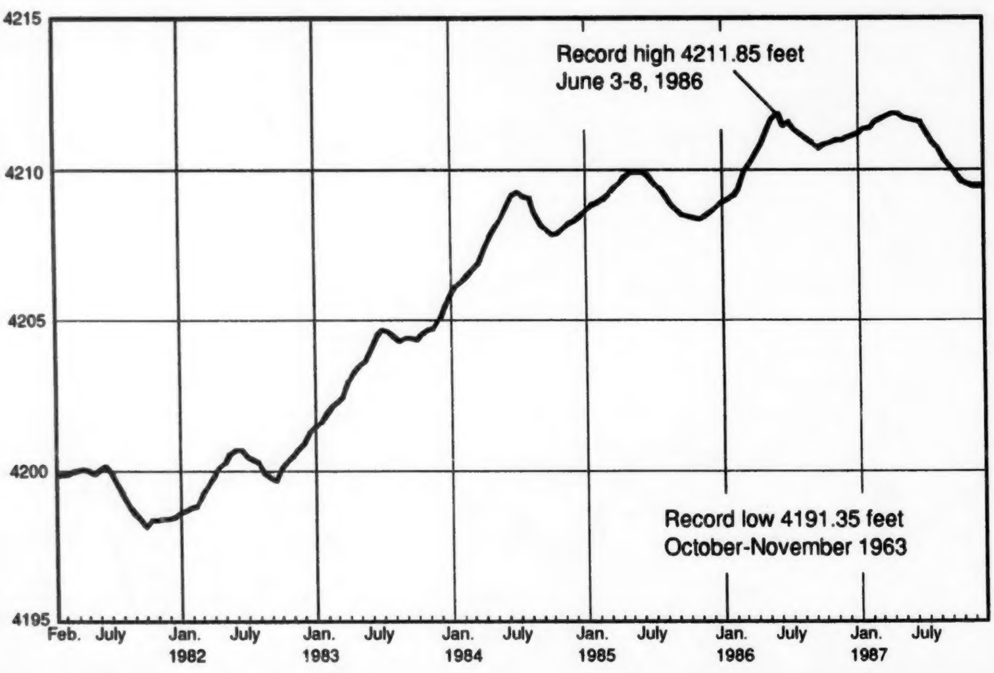
GREAT LAKES ELEVATIONS

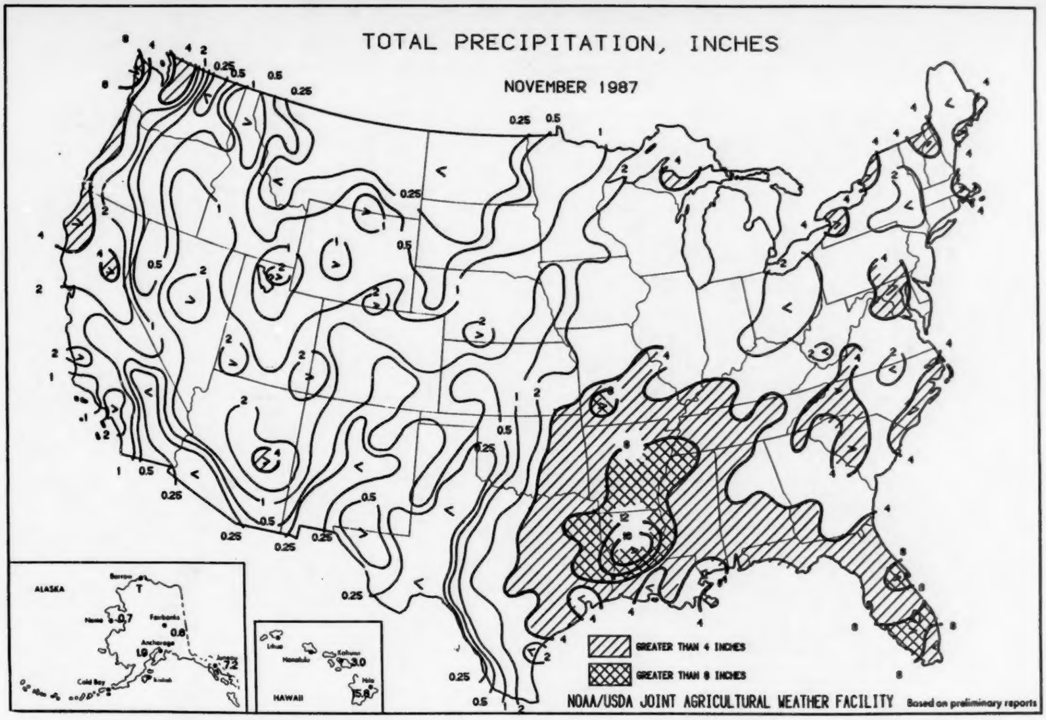
Area between light-weight solid lines indicates range between highest and lowest record for the month. Dashed line indicates median of monthly values for reference period, 1951-80. Heavy line indicates mean for current period. Data from National Ocean Service.

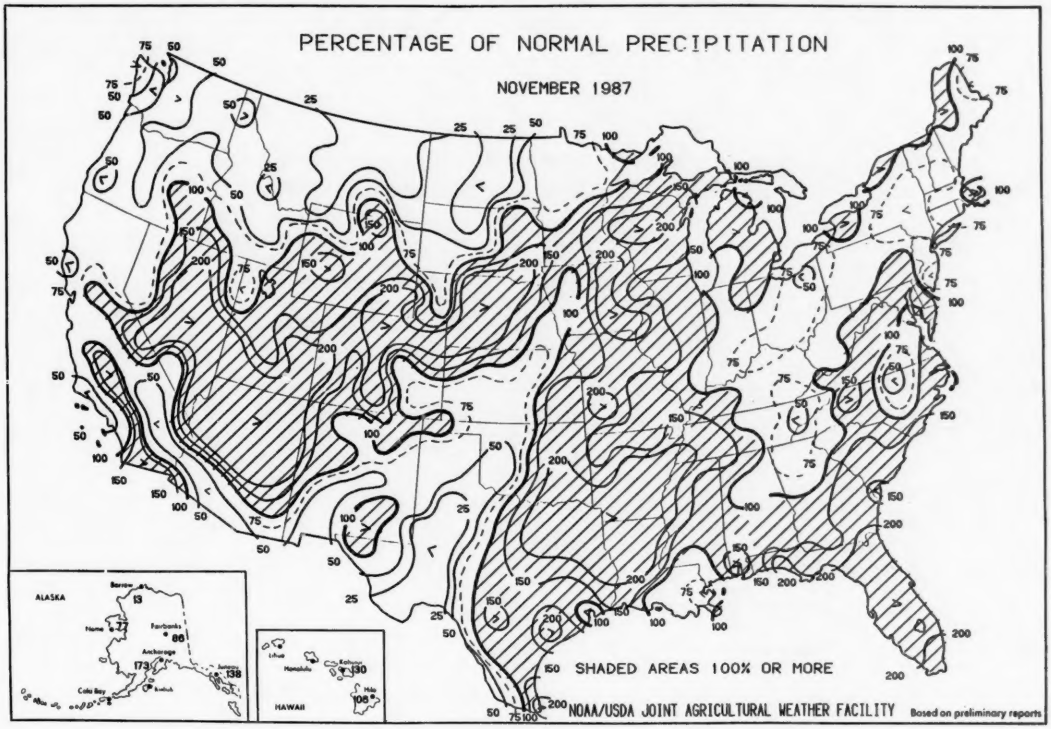


ELEVATION, IN FEET ABOVE NATIONAL GEODETIC VERTICAL DATUM OF 1929

Fluctuations of Great Salt Lake, February 1981 through November 1987



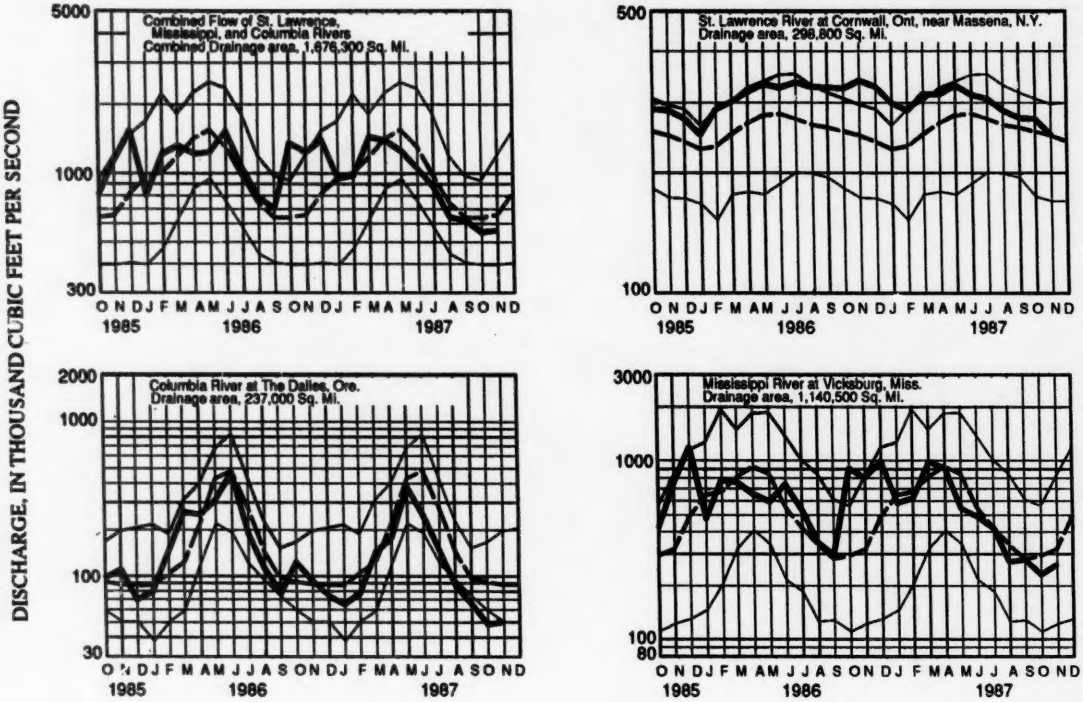




(From *Weekly Weather and Crop Bulletin* prepared and published by the NOAA/USDA Joint Agricultural Weather Facility)

HYDROGRAPHS FOR THE "BIG THREE" RIVERS

Area between light-weight solid lines indicates range between highest and lowest record for the month. Dashed line indicates median of monthly values for reference period, 1951-80. Heavy line indicates mean for current period.



Provisional data; subject to revision

DISSOLVED SOLIDS AND WATER TEMPERATURES, FOR NOVEMBER 1987, AT DOWNSTREAM SITES ON FIVE LARGE RIVERS

Station number	Station name	November data of following calendar years	Stream discharge during month: Mean (cfs)	Dissolved-solids concentration[a]: Minimum (mg/L)	Dissolved-solids concentration[a]: Maximum (mg/L)	Dissolved-solids discharge[a] (tons per day): Mean	Dissolved-solids discharge[a] (tons per day): Minimum	Dissolved-solids discharge[a] (tons per day): Maximum	Water temperature[b]: Mean in °C	Water temperature[b]: Minimum, in °C	Water temperature[b]: Maximum, in °C
01463500	Delaware River at Trenton, N.J. (Morrisville, Pa.).	1987	10,430	80	113	2,760	1,930	5,100	7.5	4.0	11.5
		1944—86	10,070	55	151	. . . .	469	12,300	. . .	2.0	19.0
		(Extreme yr)		(1955)	(1964)		(1963)	(1972)			
			[c]9,825								
07289000	Mississippi River at Vicksburg, Miss.	1987	262,800	269	328	215,200	162,500	315,200	13.5	12.0	18.5
		1975—86	487,300	181	305	312,600	123,000	677,800	13.5	8.0	20.0
		(Extreme yr)		(1984)	(1983)		(1976)	(1985)			
			[c]320,600								
03612500	Ohio River at lock and dam 53, near Grand Chain, Ill. (streamflow station at Metropolis, Ill.).	1987	83,100	[d]215	[d]251	. . . .	[d]47,700	[d]68,300	. . .	[d]11.0	[d]14.5
		1954—86	182,600	129	425	. . . .	13,900	406,000	. . .	1.0	19.5
		(Extreme yr)		(1957)	(1968)		(1986)	(1957)			
			[c]147,600								
06934500	Missouri River at Hermann, Mo. (60 miles west of St. Louis, Mo.).	1987	64,400	404	516	80,500	61,700	109,000	11.0	7.5	14.0
		1975—86	92,540	204	506	93,950	43,600	246,000	9.0	3.5	15.0
		(Extreme yr)		(1985)	(1980, 1986)		(1976)	(1985)			
			[c]54,680								
14128910	Columbia River at Warrendale, Oreg. (streamflow station at The Dalles, Oreg.).	1987	108,000	97	103	29,400	22,000	35,000	13.0	11.5	15.0
		1975—86	134,200	38	128	37,800	10,800	66,400	11.0	3.0	14.5
		(Extreme yr)		(1980)	(1978)		(1980)	(1978)			
			[c]87,960								

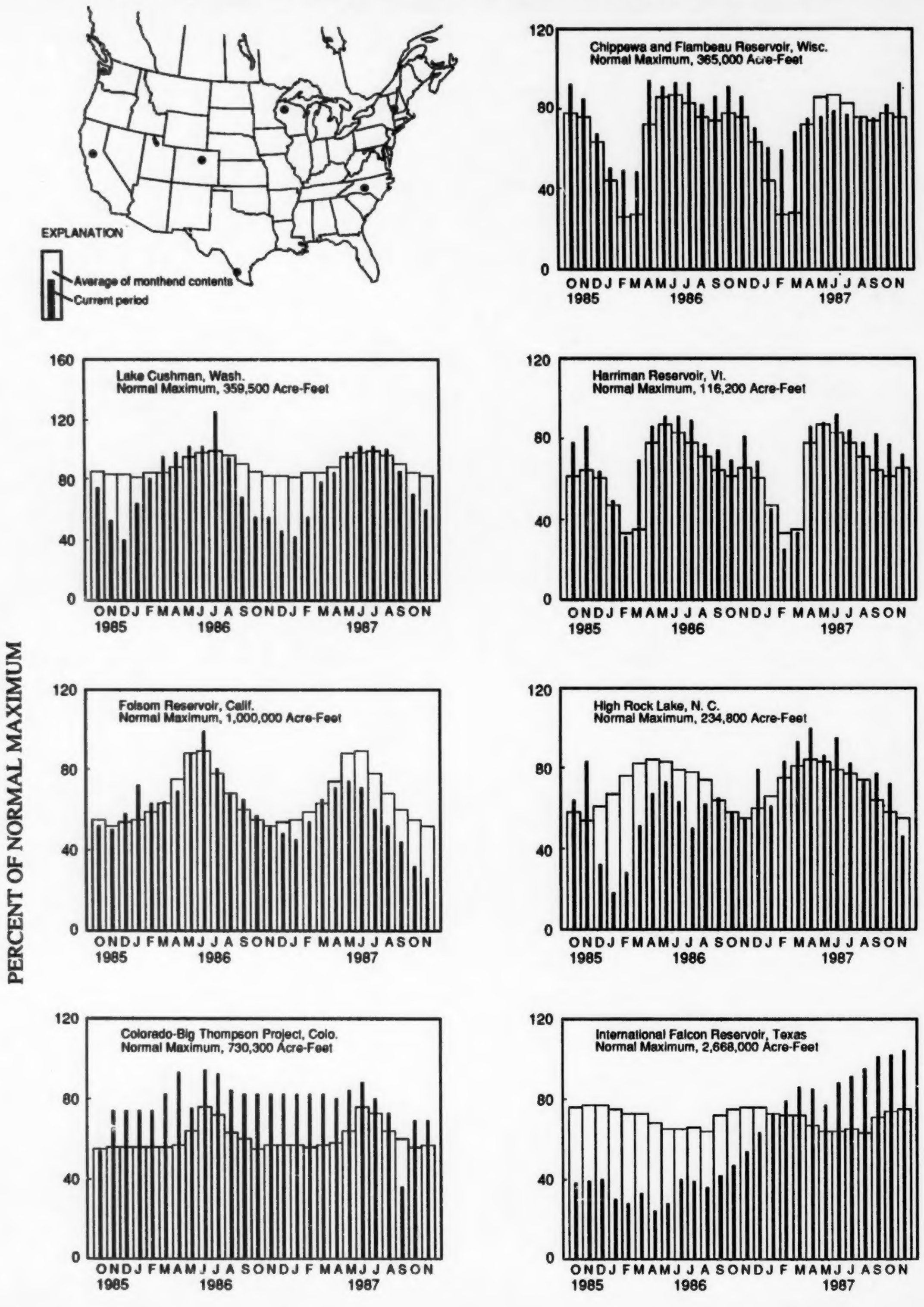
[a]Dissolved-solids concentrations, when not analyzed directly, are calculated on basis of measurements of specific conductance.
[b]To convert °C to °F: [(1.8 X °C) + 32] = °F.
[c]Median of monthly values for 30-year reference period, water years 1951—80, for comparison with data for current month.
[d]Data availble for only 10 intermittent days in November.

FLOW OF LARGE RIVERS DURING NOVEMBER 1987

Station number	Stream and place of determination	Drainage area (square miles)	Average discharge through September 1980 (cubic feet per second)	November 1987: Monthly mean discharge (cubic feet per second)	November 1987: Percent of median monthly discharge, 1951–80	November 1987: Change in discharge from previous month (percent)	November 1987: Discharge near end of month: Cubic feet per second	November 1987: Discharge near end of month: Million gallons per day	November 1987: Discharge near end of month: Date
01014000	St. John River below Fish River at Fort Kent, Maine	5,690	9,647	7,140	101	+24	3,710	2,397	30
01318500	Hudson River at Hadley, N.Y.	1,664	2,909	3,110	129	+3	2,840	1,835	30
01357500	Mohawk River at Cohoes, N.Y.	3,456	5,734	5,780	121	−13	5,000	3,200	30
01463500	Delaware River at Trenton, N.J.	6,780	11,750	10,430	106	+13	19,000	12,300	30
01570500	Susquehanna River at Harrisburg, Pa.	24,100	34,530	20,960	85	+33	21,200	13,700	29
01646500	Potomac River near Washington, D.C.	11,560	[1]11,490	[1]5,920	133	+80	37,100	23,980	30
02105500	Cape Fear River at William O. Huske Lock near Tarheel, N.C.	4,810	5,005	1,270	65	+43	.....	.....	...
02131000	Pee Dee River at Peedee, S.C.	8,830	9,851	5,460	121	+56	12,800	8,270	30
02226000	Altamaha River at Doctortown, Ga.	13,600	13,880	2,109	42	+12	2,660	1,719	27
02320500	Suwannee River at Branford, Fl.	7,880	6,987	2,970	89	−14	2,900	1,870	30
02358000	Apalachicola River at Chattahoochee, Fl	17,200	22,570	6,650	59	−16	7,940	5,131	30
02467000	Tombigbee River at Demopolis lock and dam near Coatopa, Ala.	15,400	23,300	2,310	37	+191	8,600	5,560	30
02489500	Pearl River near Bogalusa, La.	6,630	9,768	2,781	109	+21	3,050	1,971	30
03049500	Allegheny River at Natrona, Pa.	11,410	[1]19,480	[1]13,300	97	−7	15,900	10,280	29
03085000	Monongahela River at Braddock, Pa.	7,337	[1]12,510	[1]4,370	57	−1	4,200	2,710	28
03193000	Kanawha River at Kanawha Falls, W.Va.	8,367	12,590	4,230	54	+49	4,530	2,927	24
03234500	Scioto River at Higby, Ohio	5,131	4,547	875	54	+12	1,090	704	30
03294500	Ohio River at Louisville, Ky.[2]	91,170	11,600	45,700	73	+12	64,100	41,430	30
03377500	Wabash River at Mount Carmel, Ill.	28,635	27,220	4,798	43	+5	9,590	6,198	30
03469000	French Broad River below Douglas Dam, Tenn.	4,543	6,798	2,030	43	+126	.....	.....	...
04084500	Fox River at Rapide Croche Dam, near Wrightstown, Wis.[2]	6,150	4,163	4,008	114	+103	6,042	3,905	30
04264331	St. Lawrence River at Cornwall, Ontario–near Massena, N.Y.[3]	298,800	242,700	248,000	100	−9	247,000	159,600	30
02NG001	St. Maurice River at Grand Mere, Quebec	16,300	25,150	23,100	128	+38	23,500	15,190	30
05082500	Red River of the North at Grand Forks, N.Dak.	30,100	2,551	674	53	+2	657	424	23
05133500	Rainy River at Manitou Rapids, Minn.	19,400	11,830	8,040	82	−14	8,230	5,319	23
05330000	Minnesota River near Jordan, Minn.	16,200	3,402	581	65	+2	565	365	30
05331000	Mississippi River at St. Paul, Minn.	36,800	[1]10,610	4,953	79	+5	4,800	3,100	30
05365500	Chippewa River at Chippewa Falls, Wis.	5,600	5,100	3,140	81	+39	4,500	2,910	29
05407000	Wisconsin River at Muscoda, Wis.	10,300	8,617	5,973	91	+47	7,657	4,948	30
05446500	Rock River near Joslin, Ill.	9,551	5,873	4,960	131	+4	7,010	4,530	30
05474500	Mississippi River at Keokuk, Iowa	119,000	62,620	41,530	90	+26	53,800	34,770	30
06214500	Yellowstone River at Billings, Mont.	11,796	7,038	2,600	67	−3	2,490	1,609	30
06934500	Missouri River at Hermann, Mo.	524,200	79,490	62,240	114	+17	83,900	54,230	30
07289000	Mississippi River at Vicksburg, Miss.[4]	1,140,500	576,600	262,800	82	+14	312,000	201,600	25
07331000	Washita River near Dickson, Okla.	7,202	1,368	1,329	337	+21	1,342	867	30
08276500	Rio Grande below Taos Junction Bridge, near Taos, N.Mex.	9,730	725	570	136	+91	600	390	30
09315000	Green River at Green River, Utah	44,850	6,298	3,953	143	+32	....	....	..
11425500	Sacramento River at Verona, Calif.	21,257	18,820	6,992	54	−6	7,008	4,529	30
13269000	Snake River at Weiser, Idaho	69,200	18,050	11,900	79	−5	12,300	7,950	30
13317000	Salmon River at White Bird, Idaho	13,550	11,250	3,200	62	+11	2,890	1,867	29
13342500	Clearwater River at Spalding, Idaho	9,570	15,480	1,050	21	−41	730	471	30
14105700	Columbia River at The Dalles, Oreg.[5]	237,000	[1]193,100	[1]50,300	57	+4	94,100	60,820	29
14191000	Willamette River at Salem, Oreg.	7,280	[1]23,510	[1]4,880	18	+96	9,680	6,256	29
15515500	Tanana River at Nenana, Alaska	25,600	23,460	11,370	136	−38	10,000	6,000	30
08MF005	Fraser River at Hope, British Columbia.	83,800	96,290	43,080	74	+17	36,720	23,730	30

[1]Adjusted.
[2]Records furnished by Corps of Engineers.
[3]Records furnished by Buffalo District, Corps of Engineers, through International St. Lawrence River Board of Control. Discharges shown are considered to be the same as discharge at Ogdensburg, N.Y. when adjusted for storage in Lake St. Lawrence.
[4]Records of daily discharge computed jointly by Corps of Engineers and Geological Survey.
[5]Discharge determined from information furnished by Bureau of Reclamation, Corps of Engineers, and Geological Survey.

USABLE CONTENTS OF SELECTED RESERVOIRS AND RESERVOIR SYSTEMS



USABLE CONTENTS OF SELECTED RESERVOIRS NEAR END OF NOVEMBER 1987

[Contents are expressed in percent of reservoir capacity. The usable storage capacity of each reservoir is shown in the column headed "Normal maximum."]

Reservoir Principal uses: F–Flood control I–Irrigation M–Municipal P–Power R–Recreation W–Industrial	Percent of normal maximum				Normal maximum[a] (acre-feet)
	End of Nov. 1987	End of Nov. 1986	Average for end of Nov.	End of Oct. 1987	
NOVA SCOTIA					
Rossignol, Mulgrave, Falls Lake, St. Margaret's Bay, Black, and Ponhook Reservoirs(P)	39	36	40	34	[b]226,300
QUEBEC					
Allard (P)	24	82	62	42	280,600
Gouin (P)	48	94	69	49	6,954,000
MAINE					
Seven reservoir systems (MP)	49	55	56	51	4,107,000
NEW HAMPSHIRE					
First Connecticut Lake (P)	70	66	73	73	76,450
Lake Francis (FPR)	80	78	78	78	99,310
Lake Winnipesaukee (PR)	63	68	60	75	165,700
VERMONT					
Harriman (P)	72	81	65	77	116,200
Somerset (P)	88	88	71	90	57,390
MASSACHUSETTS					
Cobble Mountain and Borden Brook (MP)	79	70	72	78	77,920
NEW YORK					
Great Sacandaga Lake (FPR)	83	66	56	97	786,700
Indian Lake (FMP)	53	69	60	43	103,300
New York City reservoir system (MW)	87	84	65	80	1,680,000
NEW JERSEY					
Wanaque (M)	79	68	66	76	85,100
PENNSYLVANIA					
Allegheny (FPR)	35	35	35	44	1,180,000
Pymatuning (FMR)	94	80	80	97	188,000
Raystown Lake (FR)	68	67	54	67	761,900
Lake Wallenpaupack (PR)	44	69	52	43	157,800
MARYLAND					
Baltimore municipal system (M)	85	60	82	81	261,900
NORTH CAROLINA					
Bridgewater (Lake James) (P)	92	95	78	91	288,800
Narrows (Badin Lake) (P)	92	84	92	85	128,900
High Rock Lake (P)	46	55	55	72	234,800
SOUTH CAROLINA					
Lake Murray (P)	77	85	61	77	1,614,000
Lakes Marion and Moultrie (P)	75	83	65	73	1,862,000
SOUTH CAROLINA—GEORGIA					
Clark Hill (FP)	37	35	51	43	1,730,000
GEORGIA					
Burton (PR)	87	97	59	95	104,000
Sinclair (MPR)	88	91	74	87	214,000
Lake Sidney Lanier (FMPR)	38	38	50	41	1,686,000
ALABAMA					
Lake Martin (P)	76	81	62	81	1,375,000
TENNESSEE VALLEY					
Clinch Projects: Norris and Melton Hill Lakes (FPR)	22	33	31	28	2,293,000
Douglas Lake (FPR)	13	26	18	16	1,394,000
Hiwassee Projects: Chatuge, Nottely, Hiwassee, Apalachia, Blue Ridge, Ocoee 3, and Parksville Lakes (FPR)	52	57	43	55	1,012,000
Holston Projects: South Holston, Watauga, Boone, Fort Patrick Henry, and Cherokee Lakes (FPR)	37	43	36	40	2,880,000
Little Tennessee Projects: Nantahala, Thorpe, Fontana, and Chilhowee Lakes (FPR)	41	44	41	46	1,478,000
WISCONSIN					
Chippewa and Flambeau (PR)	93	86	76	82	365,000
Wisconsin River (21 reservoirs) (PR)	61	80	67	49	399,000
MINNESOTA					
Mississippi River headwater system (FMR)	32	34	27	37	1,640,000
NORTH DAKOTA					
Lake Sakakawea (Garrison) (FIPR)	83	91	87	83	22,700,000
SOUTH DAKOTA					
Angostura (I)	66	90	71	67	130,768
Belle Fourche (I)	60	57	40	57	185,200
Lake Francis Case (FIP)	54	50	53	61	4,589,000
Lake Oahe (FIP)	81	86	. . .	82	22,240,000
Lake Sharpe (FIP)	102	101	97	100	1,697,000
Lewis and Clark Lake (FIP)	100	85	101	90	432,000
NEBRASKA					
Lake McConaughy (IP)	75	80	68	75	1,948,000
OKLAHOMA					
Eufaula (FRP)	96	104	91	93	2,378,000
Keystone (FPR)	86	97	98	79	661,000
Tenkiller Ferry (FPR)	116	113	100	100	628,200
Lake Altus (FIMR)	86	100	45	84	133,000
Lake O'The Cherokees (FPR)	62	96	84	85	1,492,000
OKLAHOMA—TEXAS					
Lake Texoma (FMPRW)	88	102	92	89	2,722,000
TEXAS					
Bridgeport (IMW)	82	92	47	85	386,400
Canyon (FMR)	85	97	78	83	385,600
International Amistad (FIMPW)	98	82	85	98	3,497,000
International Falcon (FIMPW)	104	54	75	102	2,668,000
Livingston (IMW)	98	104	87	95	1,788,000
Possum Kingdom (IMPRW)	64	95	98	65	570,200
Red Bluff (PI)	70	69	28	70	307,000
Toledo Bend (P)	79	85	81	75	4,472,000
Twin Buttes (FIM)	78	43	30	77	177,800
Lake Kemp (IMW)	85	102	86	88	268,000
Lake Meredith (FWM)	37	29	38	37	796,900
Lake Travis (FIMPRW)	88	100	78	84	1,144,000
MONTANA					
Canyon Ferry (FIMPR)	77	87	89	77	2,043,000
Fort Peck (FPR)	83	85	85	83	18,910,000
Hungry Horse (FIPR)	63	80	84	67	3,451,000
WASHINGTON					
Ross (PR)	61	88	79	79	1,052,000
Franklin D. Roosevelt Lake (IP)	94	99	100	93	5,022,000
Lake Chelan (PR)	58	71	65	74	676,100
Lake Cushman (PR)	60	55	82	70	359,500
Lake Merwin (P)	99	99	91	100	245,600
IDAHO					
Boise River (4 reservoirs) (FIP)	28	53	53	20	1,235,000
Coeur d'Alene Lake (P)	43	67	54	57	238,500
Pend Oreille Lake (FP)	29	35	49	28	1,561,000
IDAHO—WYOMING					
Upper Snake River (8 reservoirs) (MP)	34	59	57	23	4,401,000
WYOMING					
Boysen (FIP)	84	87	80	88	802,000
Buffalo Bill (IP)	45	65	71	43	421,300
Keyhole (F)	40	34	42	40	193,800
Pathfinder, Seminoe, Alcova, Kortes, Glendo, and Guernsey Reservoirs (I)	57	67	49	56	3,056,000
COLORADO					
John Martin (FIR)	70	71	16	68	364,400
Taylor Park (IR)	71	71	54	73	106,200
Colorado-Big Thompson project (I)	69	82	57	69	730,300
COLORADO RIVER STORAGE PROJECT					
Lake Powell; Flaming Gorge, Fontenelle, Navajo, and Blue Mesa Reservoirs (IFPR)	89	91	. . .	89	31,620,000
UTAH—IDAHO					
Bear Lake (IPR)	70	79	59	69	1,421,000
CALIFORNIA					
Folsom (FIP)	26	51	52	32	1,000,000
Hetch Hetchy (MP)	51	51	43	57	360,400
Isabella (FIR)	25	43	25	25	568,100
Pine Flat (FI)	16	56	42	14	1,001,000
Clair Engle Lake (Lewiston) (P)	61	73	71	66	2,438,000
Lake Almanor (P)	77	69	50	87	1,036,000
Lake Berryessa (FIMW)	62	84	76	62	1,600,000
Millerton Lake (FI)	35	29	40	29	503,200
Shasta Lake (FIPR)	53	70	65	50	4,377,000
CALIFORNIA—NEVADA					
Lake Tahoe (IPR)	32	68	47	37	744,600
NEVADA					
Rye Patch (I)	30	65	58	31	194,300
ARIZONA—NEVADA					
Lake Mead and Lake Mohave (FIMP)	93	92	71	92	27,970,000
ARIZONA					
San Carlos (IP)	54	71	21	53	935,100
Salt and Verde River system (IMPR)	80	81	39	60	2,019,100
NEW MEXICO					
Conchas (FIR)	91	93	79	92	330,100
Elephant Butte and Caballo (FIPR)	90	96	33	89	2,442,000

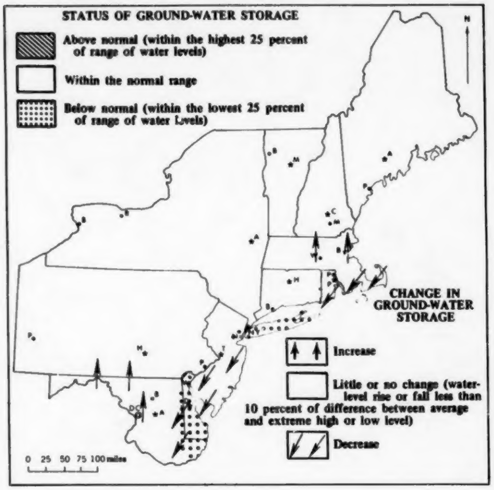
[a]1 acre-foot = 0.04356 million cubic feet = 0.326 million gallons = 0.504 cubic feet per second day.
[b]Thousands of kilowatt-hours (the potential electric power that could be generated by the volume of water in storage).

GROUND-WATER CONDITIONS DURING NOVEMBER 1987

Ground-water levels rose in east-central Massachusetts and adjacent parts of New Hampshire and Rhode Island. (See map.) Levels rose also in central and western Maryland and adjoining south-central Pennsylvania. Levels declined in Delaware and southern New Jersey and also in southeastern Massachusetts and southern Rhode Island. Elsewhere in the region there was a mixed pattern of rising and falling water levels. Levels near the end of November were in the normal range for this time of year in most of the region. Levels were below normal in Delaware and on Long Island, New York.

In the Southeastern States, ground-water levels declined during November in Kentucky, rose in West Virginia, Louisiana, and Mississippi, and also in most observation wells in Georgia. Net changes in levels were mixed in Virginia, North Carolina, and Arkansas. Water-levels were above long-term averages in Kentucky and below average in Arkansas and Louisiana. Levels were mixed with respect to average in West Virginia, Virginia, and North Carolina. Despite a slight net rise during November, a new low for the month occurred in the key well in Memphis in western Tennessee.

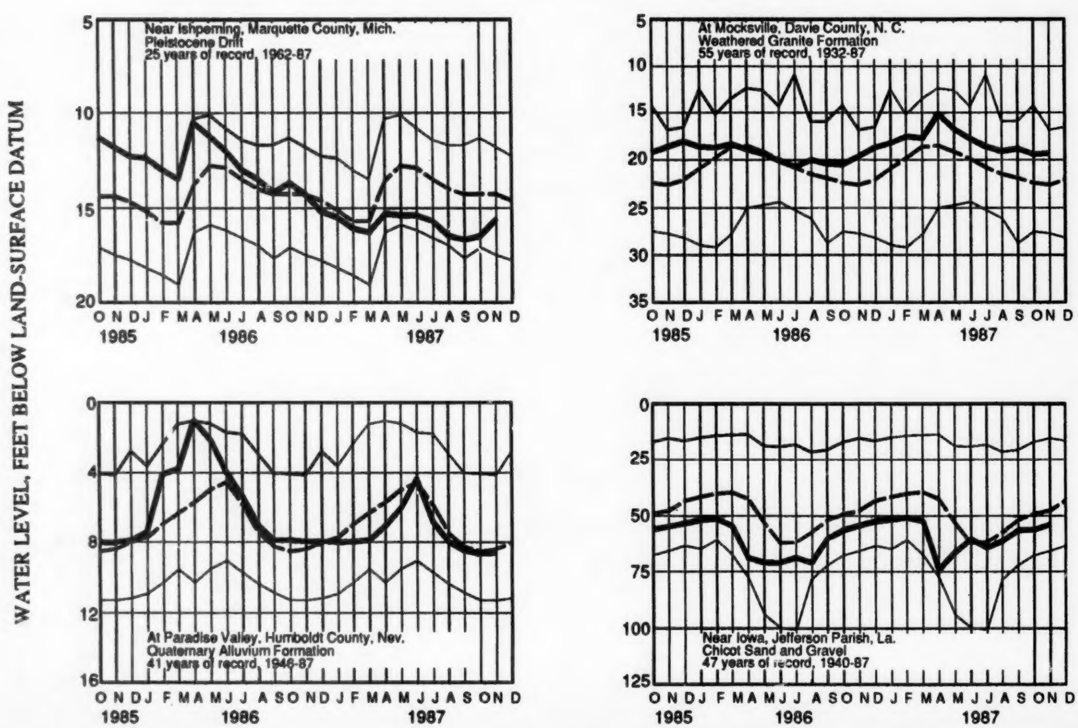
In the central and western Great Lakes States, ground-water levels declined in shallow aquifers in Wisconsin, and in key wells in Indiana. Levels also declined in many observation wells in Minnesota. Water levels rose in Michigan, and mixed changes in level occurred in Iowa. Levels were mostly above average in Iowa, near average in Wisconsin, and mixed with respect to average in Michigan. Levels were below average in Indiana and mostly below average in Minnesota.



Map showing ground-water storage near end of November and change in ground-water storage from end of October to end of November.

MONTHEND GROUND-WATER LEVELS IN KEY WELLS

Area between light-weight solid lines indicates range between highest and lowest record for the month. Dashed line indicates average of monthly levels in previous years. Heavy line indicates level for current period.



In the Western States, ground-water levels declined in North Dakota, and declined or held steady in Arizona. Mixed water-level changes occurred in Washington, Idaho, Nebraska, southern California, Nevada, Utah, Kansas, New Mexico, and Texas. Levels were above long-term averages in Nebraska and below average in Arizona. Levels were mixed with respect to average in Washington, Idaho, North Dakota, southern California, Nevada, Utah, Kansas, New Mexico, and Texas. New November high ground-water levels occurred in the Steptoe Valley well in Nevada, in the Blanding well in Utah (despite a slight net decline during the month), and in the Berrendo-Smith observation well in New Mexico. New November low levels occurred in the Las Vegas Valley well in Nevada, in the Holladay well in Utah, in the Kansas Agricultural Experiment Station key well in Colby, Kansas, in the Dayton observation well in New Mexico, and in the key well in El Paso in western Texas. The new low November levels in Nevada, Utah, Kansas, and Texas were all established despite net rises during the month.

Provisional data; subject to revision

WATER LEVELS IN KEY OBSERVATION WELLS IN SOME REPRESENTATIVE AQUIFERS IN THE CONTERMINOUS UNITED STATES--NOVEMBER 1987

Aquifer and Location	Water level in feet with reference to land-surface datum	Departure from average in feet	Net change in water level in feet since:		Year records began	Remarks
			Last month	Last year		
Glacial drift at Hanska, south-central Minnesota.	−13.02	−4.75	−2.72	−7.52	1942	
Glacial drift at Roscommon in north-central part of Lower Peninsula, Michigan.	−5.35	−0.49	+0.01	−1.84	1935	
Glacial drift at Marion, Iowa	−4.37	+2.07	+0.51	−1.05	1941	
Glacial drift at Princeton in northwestern Illinois.	−7.15	+7.05	−0.55	+0.85	1943	
Petersburg Granite, southeastern Piedmont near Fall Zone, Colonial Heights, Virginia.	−17.46	−1.16	−0.20	−0.63	1939	
Glacial outwash sand and gravel, Louisville, Kentucky (U.S. well no. 2).	−19.27	+5.88	−0.02	−1.12	1946	
500-foot sand aquifer near Memphis, Tennessee (U.S. well no. 2).	−106.68	−16.72	+0.30	−1.15	1941	Nov. low.
Weathered granite, Mocksville area, Davie County, western Piedmont, North Carolina.	−19.31	+1.50	+0.10	+0.31	1932	
Sparta Sand in Pine Bluff industrial area, Arkansas.	−235.00	−28.24	−0.50	−11.05	1958	
Eutaw Formation in the City of Montgomery, Alabama (U.S. well no. 4).	−28.4	−5.3	+1.1	−3.3	1952	
Limestone aquifer on Cockspur Island, Savannah area, Georgia (U.S. well no. 6).	−34.84	−7.49	+0.26	+1.01	1956	
Sand and gravel in Puget Trough, Tacoma, Washington.	−104.58	+4.84	+0.35	−2.12	1952	
Pleistocene glacial outwash gravel, North Pole, northern Idaho (U.S. well no. 3).	−465.2	−4.9	−0.8	−2.1	1929	
Snake River Group: Snake River Plain Aquifer, at Eden, Idaho (U.S. well no. 4).	−119.1	−3.1	−2.2	−0.7	1957	
Alluvial valley fill in Flowell area, Millard County, Utah (U.S. well no. 9).	−16.79	+11.54	+1.34	−10.29	1929	
Alluvial sand and gravel, Platte River Valley, Ashland, Nebraska (U.S. well no. 6).	−4.30	+1.91	−0.15	−2.10	1935	
Alluvial valley fill in Steptoe Valley, Nevada	−7.39	+5.45	+0.47	+0.31	1950	Nov. low.
Pleistocene terrace deposits in Kansas River valley, at Lawrence, northeastern Kansas.	−20.14	+0.45	−0.48	−5.04	1953	
Alluvium and Paso Robles clay, sand, and gravel, Santa Maria, California	−127.60	+14.92	−0.91	−10.30	1957	
Valley fill, Elfrida area, Douglas, Arizona (U.S. well no. 15).	−103.3	−22.0	0.0	+0.2	1951	
Hueco bolson, El Paso area, Texas	−266.79	−18.81	+0.04	−0.64	1965	Nov. low.
Evangeline aquifer, Houston area, Texas	−306.50	−1.97	+5.00	+9.10	1965	

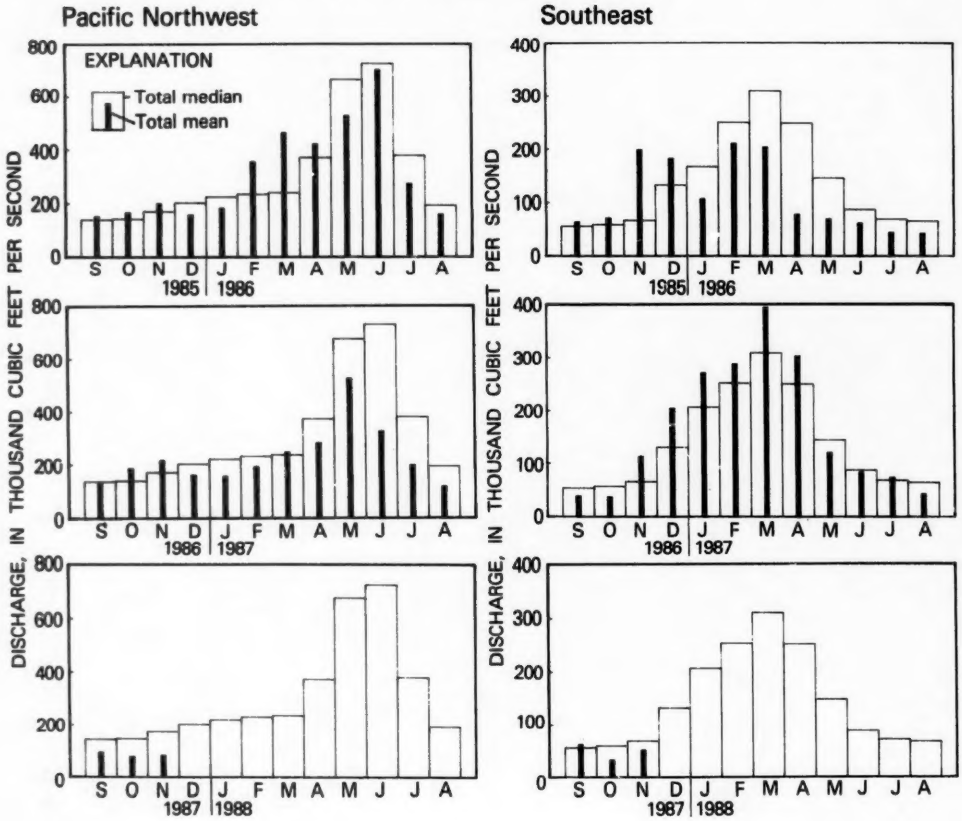
(Continued from page 2.)

The following reservoirs or reservoir systems had both a decline of more than 5 percent of normal maximum contents during the month and monthend contents more than 5 percent of normal maximum contents below monthend averages: Allard (Quebec); High Rock Lake (North Carolina); Clark Hill (South Carolina-Georgia); the Clinch Projects (Tennessee Valley); Lake O' The Cherokees (Oklahoma); Coeur d'Alene Lake (Idaho); Lake Chelan and Lake Cushman (Washington); and Folsom Lake (California). In contrast, only the Chippewa and Flambeau reservoir system (Wisconsin), and Tenkiller Ferry (Oklahoma), had both an increase of more than 5 percent of normal maximum contents during the month and monthend contents that were more than 5 percent of normal maximum contents above monthend averages. Graphs of contents for seven reservoirs are shown on page 10 with contents for the 100 reporting reservoirs given on page 11.

The combined flow of the 3 largest rivers in the lower 48 States--Mississippi, St. Lawrence, and Columbia--averaged a below-normal 561,100 cfs (about 15 percent below median) during November after decreasing about 2 percent from October to November. This month's combined flow was about 22 percent lower than that for November 1982, the second lowest combined flow for November during the period 1982-87. Mean flow of the St. Lawrence River at Cornwall, Ontario, decreased by about 9 percent from that for October and moved into the normal range after being in the above-normal range last month. Mean flow of the Mississippi River at Vicksburg, Mississippi, increased by about 14 percent from that for October, and moved into the normal range after 1 month in the below-normal range. Mean flow of the Columbia River at The Dalles, Oregon, was in the below-normal range for the sixth consecutive month, and was only 70 cfs above the November record low (50,230 cfs, set in 1936) after increasing by about 4 percent from October to November. Flow hydrographs for both the combined and individual flows of the "Big 3" are shown on page 8. Dissolved solids and water temperatures at five large river stations are given on page 8. November flows of the "Big 3" and other large rivers are given in the Flow of Large Rivers table on page 9.

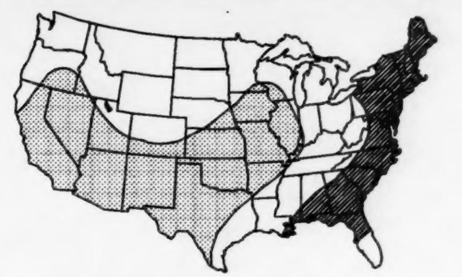
November precipitation (provisional National Weather Service data) was generally an inch or more below normal only in parts of Hawaii, coastal areas of the Pacific Northwest, parts of the Northeast, and scattered sites in the Southeast. Precipitation was generally an inch or more above average in Puerto Rico, much of the area from Florida to Maryland, and also much of the area from Texas to Wisconsin. Record-high November precipitation (amounts in inches) occurred at only four cities: Little Rock (10.18), Arkansas; Orlando (10.29), Florida; Shreveport (10.81), Louisiana; Memphis (10.45), Tennessee; and Valentine (1.96), Nebraska. No record low totals occurred. Total Precipitation and Percentage of Normal Precipitation maps are on page 7. December 1987 through February 1988 outlook maps for both temperature and precipitation are on page 15.

STREAMFLOW IN THE PACIFIC NORTHWEST AND IN THE SOUTHEAST, SEPTEMBER 1985 THROUGH NOVEMBER 1987



TEMPERATURE OUTLOOK FOR DECEMBER 1987 THROUGH FEBRUARY 1988

PRECIPITATION OUTLOOK FOR DECEMBER 1987 THROUGH FEBRUARY 1988



NATIONAL WATER CONDITIONS

NOVEMBER 1987

Based on reports from the Canadian and U.S. Field offices; completed December 23, 1987

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EXPLANATION OF DATA (Revised December 1987)

Cover map shows generalized pattern of streamflow for the month based on provisional data from 183 index gaging stations--18 in Canada, 163 in the United States, and 2 in the Commonwealth of Puerto Rico. Alaska, Hawaii, and Puerto Rico inset maps show streamflow only at the index gaging stations that are located near the point shown by the arrows. Classifications on map are based on comparison of streamflow for the current month at each index station with the flow for the same month in the 30-year reference period, 1951-80. Shorter reference periods are used for one Canadian index station, two Kansas index stations, one New York index station, and the Puerto Rico index stations because of the limited records available.

The *persistence/change map* shows where streamflow has persisted in the above- or below-normal range from last month to this month and also where streamflow is in the above- or below-normal range this month after being in a different range last month. The pie charts show percent of stations reporting discharges in each flow range for the conterminous United States, southern Canada, the two areas combined, and also the percent of area in each flow range for the conterminous United States and southern Canada. The bar graph shows total mean and total median flow for all reporting stations.

The comparative data are obtained by ranking the 30 flows for each month of the reference period in order of decreasing magnitude--the highest flow is given a ranking of 1 and the lowest flow is given a ranking of 30. Quartiles (25-percent points) are computed by averaging the 7th and 8th highest flows (upper quartile), 15th and 16th highest flows (middle quartile and median), and the 23rd and 24th highest flows (lower quartile). The upper and lower quartiles set off the highest 25 percent of flows and lowest 25 percent of flows, respectively, for the reference period. The median (middle quartile) is the middle value by definition. For the reference period, 50 percent of the flows are greater than the median, 50 percent are less than the median, 50 percent are between the upper and lower quartiles (in the normal range), 25 percent are greater than the upper quartile (above normal), and 25 percent are less than the lower quartile (below normal). Flow for the current month is then classified as: *above normal* if it is greater than the upper quartile, *in the normal range* if it is between the upper and lower quartiles, and *below normal* if it is less than the lower quartile. Change in flow from the previous month to the current month is classified as *seasonal* if the change is in the same direction as the change in the median. If the change is in the opposite direction of the change in the median, the change is classified as *contraseasonal* (opposite to the seasonal change). For example: at a particular index station, the January median is greater than the December median; if flow for the current January increased from December (the previous month), the increase is seasonal; if flow for the current January decreased from December, the decrease is contraseasonal.

Flood frequency analyses define the relation of flood peak magnitude to probability of occurrence or recurrence interval. *Probability of occurrence* is the chance that a given flood magnitude will be exceeded in any one year. *Recurrence interval* is the reciprocal of probability of occurrence and is the *average* number of years between occurrences. For example, a flood having a probability of occurrence of 0.01 (1 percent) has a recurrence interval of 100 years. *Recurrence intervals imply no regularity of occurrence*; a 100-year flood might be exceeded in consecutive years or it might not be exceeded in a 100-year period.

Statements about *ground-water levels* refer to conditions near the end of the month. The water level in each key observation well is compared with average level for the end of the month determined from the 30-year reference period, 1951-80, or from the entire past record for that well when only limited records are available. Comparative data for ground-water levels are obtained in the same manner as comparative data for streamflow. *Changes in ground-water levels*, unless described otherwise, are from the end of the previous month to the end of the current month.

Dissolved solids and temperature data for November are given for five stream-sampling sites that are part of the National Stream Quality Accounting Network (NASQAN). *Dissolved solids* are minerals dissolved in water and usually consist predominately of silica and ions of calcium, magnesium, sodium, potassium, carbonate, bicarbonate, sulfate, chloride, and nitrate. *Dissolved-solids discharge* represents the total daily amount of dissolved minerals carried by the stream. *Dissolved-solids concentrations* are generally higher during periods of low streamflow, but the highest dissolved-solids *discharges* occur during periods of high streamflow because the total quantities of water, and therefore total load of dissolved minerals, are so much greater than at times of low flow.

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